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Energy wood production from private forests – nonindustrial private forest owners' perceptions and attitudes in Croatia and Serbia

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ABSTRACT

Private forests in Croatia and Serbia are highly fragmented in small plots with low productivity and owned by a large number of small-scale nonindustrial private forest owners (NIPFs). The study conducted surveys among 232 NIPFs in these two countries to find out their perceptions and attitudes related to energy wood production from their forests. The secondary objective of the study was to provide policy recommendations to the public authorities and professionals in these countries for improving the preconditions for energy wood mobilization from private forests. The study found that the NIPFs perceived underdeveloped market and low price for energy wood, absence of favorable policies, fragmented forests properties, older NIPFs' lack of interests in energy wood production, and difficulties in getting bank loan for energy wood related business activities as barriers against energy wood production from private forests. However, the NIPFs showed positive attitudes towards producing energy wood from their forests and they considered the possibilities of creating new jobs and commercial opportunities as strengths of energy wood production. The NIPFs' socio-demographic background had statistically significant relations with their perceptions and attitudes related to energy wood production. The dimensions of the NIPFs' perceptions and attitudes related to energy wood production showed two key dimensions – *institutionalists* and *enthusiasts*. The variables to explain the NIPFs' attitudes to energy wood production were different between the two countries and they indicated the differences in the country level circumstances for energy wood production. The results appeared to be relevant for understanding the issues that the NIPFs perceived as barriers against developing a viable energy wood market in their countries. When new forestry institutions and policies are emerging in these countries, the existing public and private forestry institutions need to play an important role for improving the preconditions for energy wood production from private forests.

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1. Introduction

1.1. Research background

Countries in the Western Balkan region are heavily dependent on imported fossil fuels for meeting their demand for primary energy. Share of wood fuels in primary energy production was 8% in Croatia in 2010 [1] and 3% in Serbia in 2012 [2]. Nevertheless, firewood is still a major source of energy to a large number of rural households in these countries [3]. In recent years, both the countries have taken a number of initiatives to increase production of bioenergy from their forest biomass. The importance of energy wood production from privately owned forests has been a key area of focus in many of those initiatives. It has been recognized that the rural areas in these countries would be significantly benefited through the development of a viable market for wood fuels. However, several challenges have also been identified for developing a viable wood fuel market in Croatia and Serbia. Among others, motivating a large number of small-scale family forest owners (also known as nonindustrial private forest owners or NIPFs) in these countries to produce energy wood from their forests has emerged as a key challenge. In this regard, Kajba et al. [4] have reported that in spite of significant potential for planting short rotation energy crops in Croatia, a very small area of land has actually been utilized for that purpose. They have recommended a number of actions to improve the current policy approach for the NIPFs in Croatia such as introduction of incentives and subsidies for them, improving their knowledge and expertise in growing energy crops, and increasing their collaboration with other stakeholders at a national level. In Serbian context, Domac and Panoutsou [5] estimated that bioenergy could meet about 21% of the country's total primary energy demand and forest biomass alone could contribute one-fourth of the total bioenergy supply. However, they perceived that the large number of small-scale NIPFs in Serbia would be a major barrier against developing a viable forest-based bioenergy sector.

Forests cover about 42% (ca. 2.6 million ha) of the land area in Croatia [6] and 29% (ca. 2.2 million ha) in Serbia [7]. In terms of forest ownerships, the state owns 53% of the forests in Serbia and the remaining 47% is owned by approximately 0.5 million NIPFs [7]. In general, the private forest sector in Serbia is characterized by high fragmentation of forest properties (e.g., 72% of the NIPFs own forest land less than 1 ha, 26% own 1–10 ha, and 2% own more than 10 ha) and inefficient organization of private forest management [8]. Unlike Serbia, The Croatian Forests Ltd. (‘Hrvatske šume’ Ltd.), a state owned company, manages almost 75% of the forests and forest lands in Croatia while about 0.6 million NIPFs own 22% of the forest land with an average forest property of 0.76 ha [9]. Private forests in Croatia are also characterized by: high fragmentation in several small plots where on average each NIPF has two disconnected plots, unclear property boundaries, uncertainty over forest ownerships, and poor growing stock compared to the state forests [8]. Only around 7% of the private forests have valid management plans in comparison to 95% of the state forests in Croatia [10] and the situation also seems to be similar in Serbia. In addition, private forests in these countries comprise of mainly coppices, which appear to be a major problem to the NIPFs for managing their forests [3]. Due to these reasons, the NIPFs in these countries generally show lack of interests in managing their forests as they do not consider it economically profitable [8].

Croatia has recently joined the European Union (EU) while Serbia is an EU ‘candidate’ country, and at the same time, both are the parties to the *Energy Community Treaty* of the EU. In line with the development in the EU energy sector, Croatia adopted an *Energy Development Strategy* for the period up to 2020 in 2009 [11]. The strategy has set a target of achieving 35% share of renewables in electricity production, 10% in transport, and 20% in heating and cooling by 2020. The strategy has also recognized locally available forest biomass in Croatia as one of the potential sources for meeting the target of electricity generation from renewables [12]. It has recommended taking actions to promote cultivation of forests including expansion of energy crop plantations and establishing biomass-fired cogeneration plants for heat and electricity production [12]. However, it has not specified any particular action for increasing energy wood production from private forests. The most important forestry related policy in Croatia is the *National Forestry Policy and Strategy* (NFPS), which came into being in 2003. The NFPS stresses importance of the economic, environmental and social functions of forests in Croatia and their major impacts on the quality of life [13]. Among other priorities fixed under the NFPS, promoting utilization of forest biomass for energy production and sustainable management of private forests were identified as the two medium and long-term priorities (i.e., to be implemented during the period 2006–2008 and beyond 2008). Although there have been some positive developments in the private forestry sector in Croatia through the implementation of the planned actions under the NFPS such as establishing a Forest Advisory Service in 2007 and forming the Croatian Union of Private Forest Owners' Associations in 2008, not much has been achieved in the forest-based bioenergy sector, which is apparent by looking at the relatively very small share of bioenergy in the country's energy mix.

In the most recent renewable energy (RE) policy related developments in Croatia, the Croatian Government has adopted the *National Renewable Energy Action Plan* (NREAP) for Croatia in 2013 with a target to achieve 20% share of renewables in its primary energy consumption by 2020 from the current 15%. The Croatian NREAP has set a target for achieving 39% share of renewables in electricity production while the targets for transport and heating and cooling remained similar with the country's earlier *Energy Development Strategy of 2009* [14]. Along with other RE sources such as large and small-hydro, wind, and cogeneration, the Action Plan has put an emphasis on electricity production from biomass and biogas-based power plants to achieve the high target of 39% electricity production from renewables [14]. Therefore, it is

expected that the importance of energy production from forest biomass will grow in Croatia and there will be need for improving private forest management in the country, which cannot be realized without actively engaging the NIPFs in energy biomass production from their forests.

Serbia signed and ratified the *Energy Community Treaty* in 2005 and the Serbian Government adopted the *Biomass Action Plan* in 2010 as part of the *Energy Sector Development Strategy of the Republic of Serbia by 2015* [15]. Much like Croatia, the energy policy related developments in Serbia have been in accordance with the EU guidelines in order to harness its large potential as supplier and user of solid, liquid, and gaseous biofuels [15]. Serbia, with assistance from the Dutch Government, completed the preparation of the *National Renewable Energy Action Plan* (NREAP) in 2013 to develop the RE sector in the country. However, already in 2012, Serbia adopted a much ambitious target of achieving 27% share of renewables in the country's gross final energy consumption by 2020 [16]. Biomass has been identified as the largest potential source for energy production among all other RE sources in Serbia [16] and the *Biomass Action Plan for the Republic of Serbia 2010–2012* or the BAP [17] estimated the energy potential of locally available woody and agricultural biomasses at approximately 1 Mtoe and 2 Mtoe, respectively. However, low public awareness of bioenergy among farmers, NIPFs, households, and forestry professionals including the absence of a professional association for biomass producers have been identified as the key factors affecting the forest-based bioenergy sector in Serbia [17]. Although the Serbian BAP has proposed a set of actions to address the challenges in the bioenergy sector in Serbia, it has neither proposed any specific actions to increase the mobilization of energy wood from private forests nor motivated the Serbian NIPFs for harvesting energy wood from their forests.

1.2. Literature review

There are a growing number of studies that have analyzed NIPFs' perceptions and attitudes related to energy wood supply in Europe and North America. In Europe and particularly in the Scandinavian countries, importance of bioenergy has been growing over the last decade and at present forest-based bioenergy meets about 20%, 7%, and 32% of the energy demand in Finland, Norway and Sweden, respectively [18]. In these countries, a large proportion of the forest area (ca. 60–80%) is owned by the NIPFs who collectively play a key role in supplying bulk of the roundwood used by the domestic forest-based industries. In recent years, NIPFs have also become a major supplier of harvest residues and small-diameter trees to the bioenergy producers in Finland and Sweden and it is expected that NIPFS' relevance in energy wood supply would also increase in Norway in the coming years. Therefore, many of the earlier studies conducted in Scandinavia on this topic have attempted to explore the NIPFs' perceptions and attitudes including their intentions related to harvesting energy wood from their forests.

In one of the first such studies, Bohlin and Roos [19] reported that the Swedish NIPFs sold energy wood primarily to get rid of the debris accumulated on forest grounds after harvesting operations. However, some of the Swedish NIPFs did not sell energy wood due to their concerns over losing soil nutrients from the excessive harvesting of forest residues. Similar concerns also appeared among the NIPFs in Finland though they appeared to be more positive than the Swedish NIPFs towards selling energy wood from their forests [20]. In another study, Halder et al. [21] reported that the majority of the Finnish NIPFs in North and South Karelia were not interested in selling energy wood due to its low price compared to pulp wood. In addition, it was also found that the Finnish NIPFs perceived logistical issues such as harvesting and transportation of energy wood as major barriers in mobilizing energy biomass from their forests [21]. NIPFs in Finland have also appeared to be very positive to the business of 'heat energy entrepreneurship'. Under this mode of business, individually or by forming a cooperative or a consortium the Finnish NIPFs provide heating services to a small local community or building such as a school in a rural area and thus they can diversify their income opportunities, improve local economy, and increase social networks [22]. In addition to the studies from Finland and Sweden, in a recent study from Norway, Brough et al. [23] found that the Norwegian NIPFs were very positive about supplying forest biomass for energy production and the reasons for that were their perceptions that harvesting and selling forest residues for energy production could be an important economic activity for them; it could control disease and insect damage in the forests, improve forest esthetics and environment, and contribute to sustainable forest management practices. However, much like the Finnish and Swedish NIPFs, the Norwegian NIPFs also appeared to be concerned over some of the potential negative effects of energy wood harvesting on forest environment such as loss of biodiversity and soil nutrients, increased soil erosion, and more traffic in the forests [23].

At present, bioenergy comprises of almost half of the renewable energy produced in the U.S. and a large share of it (ca. 50%) comes from woody biomass [24]. In the U.S., 10.2 million family forest owners collectively own around 100 million ha of forest land (i.e., 35% of the total forest area in the country) with an average forest holding size of 10 ha [25]. Since they own the majority of the forests in the northern and southern states in the U.S. [25], it indicates that their forest management decisions will be crucial for the future availability of forest biomass for bioenergy production [26]. In recent years, a number of studies have explored the U.S. NIPFs' perceptions, preferences, and harvest intentions with regard to energy wood supply. In one of the earlier studies, Shivan and Mehmood [26] analyzed the NIPFs' preferences for policy alternatives for promoting wood-based bioenergy by taking samples from the three southern-U.S. states (Arkansas, Virginia, and Florida). Their study found that most of the NIPFs preferred tax incentives over direct subsidy support for promoting wood-based bioenergy; however, the majority of the older NIPFs preferred the latter policy instrument. The study also found that the NIPFs with larger forest areas and managing their forests actively under timber production regime were less likely to support policy tools for promoting wood-based bioenergy. Joshi and Mehmood [27] conducted a study to find out the factors affecting the U.S. NIPFs' willingness to supply energy wood and they revealed that the young NIPFs with large forest holdings with pine or mixed pine-hardwood plantations would be more likely to supply woody biomass for bioenergy production. Their study also found that the older NIPFs did not perceive the environmental benefits of bioenergy appealing while the more educated NIPFs positively perceived the benefits of wood-based bioenergy in the context of environmental and energy security related matters in the U.S.

In another study, Shivan and Mehmood [28] found a profit-maximization nature among the NIPFs in the U.S., which showed that the percentage of the NIPFs willing to harvest forest biomass from their forests for bioenergy production increased with an increase in the amount of bid price for energy wood and it indicated that a higher price of energy wood would be a significant motivational factor for the NIPFs to harvest energy biomass from their forests. Contradictory findings also appeared from a study by Markowski-Lindsay et al. [29] where they found that the NIPFs in Massachusetts were only partially willing to harvest forest residues for bioenergy production, and their willingness was not greatly influenced by the price of energy biomass. On NIPFs' willingness to harvest woody biomass for bioenergy, contingent

upon their knowledge of bioenergy Joshi et al. [30] revealed that the elderly, male, and resident NIPFs also having large forest areas and planted pine in the past years in the State of Mississippi were likely to be more aware of wood-based bioenergy. Their study concluded that when the NIPFs were aware of wood-based bioenergy, the elderly and resident NIPFs having pine stands and giving value to economic benefits were willing to harvest woody biomass for bioenergy production.

Leitch et al. [31] applied the *Theory of Planned Behavior* (TPB) model to explain NIPFs' intent to supply energy wood in Kentucky and they reported that the majority of the NIPFs in that state were willing to harvest forest biomass for energy production and their attitudes, subjective norms, and perceived behavioral control had significant effects on their intent to harvest energy wood. However, the NIPFs in Kentucky perceived the lack of bioenergy market and access to woodland as major challenges against energy wood harvesting. Becker et al. [32] also employed the TPB model to estimate the social availability of woody biomass for energy production in the states of Minnesota and Wisconsin. They estimated the *social availability* of woody biomass as function of several factors such as NIPFs' socio-demographic backgrounds and their behavioral intent, characteristics of their forest land, and the price of biomass on their stated willingness to harvest energy wood. Butler et al. [25] defined *social availability* as "the portion of total physical availability of forest biomass accessible in the marketplace after accounting for social factors influencing landowner propensity to harvest". Based on the above concepts, Becker et al. [32] revealed that the NIPFs' willingness to harvest energy biomass was influenced by both monetary (e.g., price of energy wood offered) and non-monetary factors (e.g., soil impacts, esthetics, energy security, and social norms).

It is true that the above studies from Scandinavia and the U.S. have generated extensive information on NIPFs' knowledge, perceptions, and attitudes related to energy wood harvesting. However, their relevance seems to be much less in the Croatian and Serbian contexts due to several reasons. Firstly, from purely an economic perspective, the perceived significance of private forestry in Croatia and Serbia is much less compared to the Scandinavian countries as well as the U.S. Second, wood-based bioenergy sector is yet to become functional in the Western Balkan countries whereas it is already a well developed industry in Finland, Sweden, and the U.S. In addition, the majority of the Croatian and Serbian NIPFs own an average 1 ha of forest land whereas such figure is 24 ha in Finland [33], 50 ha in Sweden [34] and 10 ha in the U.S. [25]. Due to these differences, it could be possible that the Croatian and Serbian NIPFs' perceptions and attitudes related to energy wood production from their forests will be much different compared to the NIPFs in northern Europe and the U.S. Therefore, an analysis of the perceptions and attitudes related to energy wood production among the Croatian and Serbian NIPFs will be relevant from policy point of view for promoting wood-based bioenergy production from private forests in these countries.

1.3. Objectives

Halder et al. [21] stated that mobilizing wood for energy production from forests owned by small-scale family forest owners would be a challenging issue in many countries where such forest owners own a large share of forest land. Therefore, understanding their perceptions and attitudes related to energy wood production from their forests would be crucial for creating a viable wood supply mechanism for bioenergy production [21]. Based on these notions and the above discussions, the specific objectives of the study were to (1) analyze perceptions and attitudes of the Croatian and Serbian NIPFs related to energy wood production and also find out the effects of age, gender, residence, education, and occupation related differences on their perceptions and attitudes related to energy wood production; (2) explore the key dimensions of the NIPFs' perceptions and attitudes related to energy wood production; and (3) reveal the explanatory factors that could determine the NIPFs' attitudes to energy wood production. The findings are expected to provide policy level inputs to the public authorities and professionals for improving the pre-conditions for energy wood mobilization from private forests in Croatia and Serbia. This could also have some implications for the other Western Balkan countries.

2. Methodology

2.1. Survey method

The data for the study were collected through a questionnaire-based survey among 232 NIPFs – 82 from Croatia and 150 from Serbia. The surveys were conducted by the Croatian and Serbian researchers during April to June in 2012 when they attended some meetings involving the NIPFs in their respective countries. All the NIPFs who attended those meetings also participated in the surveys and therefore no issue emerged related to non-response bias. No incentives were provided to the respondents and all of them participated voluntarily in the survey. The original English version of the questionnaire was translated into the Croatian and Serbian languages by the local researchers and few consultations were held with them to maintain the content validity of the questionnaire. The survey instrument consisted of close-ended items and therefore, back translation into English was not required. A pilot test in each country among a group of 3 to 4 NIPFs was also conducted to improve the final version of the questionnaire. The final version of the questionnaire was identical in both the countries to maintain its consistency for comparative analysis.

2.2. Questionnaire design

The questionnaire contained a variety of questions in three broad sections. *Section A* consisted of three sub-sections and the questions within these sub-sections attempted to explore the NIPFs' (a) socio-demographic profiles (age, gender, occupation, education, and residence); (b) characteristics of forest ownerships (size of forest area, individual or joint ownership, and types of forests); (c) and energy wood use and selling from forests. *Section B* consisted of a five-point (*strongly agree to strongly disagree*) Likert-scale with twenty items to analyze the NIPFs' perceptions and attitudes related to energy wood production from their forests. Among the twenty items, fourteen items assessed the NIPFs' perceptions while six items assessed their attitudes related to energy wood production. *Section C* comprised of questions related to the NIPFS' knowledge of energy wood production, their opinions to different obstacles in energy wood production, and their preferences for policy support to increase energy wood production from their forests. The questionnaire was developed after (i) a comprehensive review of the available literature from Europe and North America on NIPFs' perceptions and attitudes related to energy wood production; (ii) considering country specific circumstances in Croatia and Serbia related to private forestry; and (iii) consulting with some researchers from Finland, Croatia, and Serbia. However, for this study, only results with regard to the NIPFs' socio-demographic profiles (age, gender, education, occupation, and residence) and their perceptions and attitudes related to energy wood production including their relationships with the NIPFs' socio-demographic profiles have been reported. Results related to the other parts of the questionnaire will be reported elsewhere. A sample of the questionnaire can be obtained from the corresponding author upon request.

2.3. Data analysis

The overall reliability of the twenty Likert-scale items that measured the NIPFs' perceptions and attitudes related to energy wood production showed adequate level of internal consistency (*Cronbach*'s α=0.78). Separately, the fourteen perceptions and six attitudes related items revealed internal consistencies as α=*0.74* and α=0.65, respectively. In terms of country-wise reliability of the twenty items, the overall reliability for Croatia was α=0.82 (α=0.79 for perceptions and α=0.67 for attitudes). In Serbia, the overall reliability of those 20 items was α=0.74 (α=0.67 for perceptions and α=0.67 for attitudes). The study used descriptive statistics, t-tests, Principal Component Analysis and Multiple Regression Analysis to analyze the structure and relationships of the NIPFs' perceptions and attitudes related to energy wood production from private forests. Data analysis was conducted by the IBM SPSS 19 statistical software package.

3. Results

3.1. Profile of the NIPFs

Profiles of the NIPFs are presented in Table 1, which include information related to all the three sub-sections under *Section A* in order to provide a broad overview of the respondents' characteristics in the study. In terms of gender, there was a strong gender bias towards the males and more than 70% of the respondents were between 31–60 years of age in both Croatia and Serbia. The majority of them had high school level qualification in both the countries. Large country level differences appeared in the NIPFs' occupational categories between the two countries. About 77% of the Croatian NIPFs were working in either public or public sector, very few were either farmers or entrepreneurs, and almost one-fifth were retired. In Serbia, about 30% of the NIPFs were working in either public or private sector, another 30% were either farmers or entrepreneurs, and 30% from the remaining were retired. More than 90% of the NIPFs in both the countries were living close to their forest properties (1–5 km). The majority of the NIPFs in both the countries reported that their forests comprised of mainly mixed forests (both high and coppice forests). However, one-fifth of the Serbian NIPFs' forests comprised of purely coppice forests whereas 17% of Croatian NIPFs' forests were purely high forests.

In terms of forest ownerships, about 88% and 61% of the Croatian and Serbian NIPFs, respectively appeared to own forest parcels alone with an average area of 2.5 ha for the Croatian NIPFs and 6.9 ha for the Serbian NIPFs. In Serbia, 20% of the NIPFs' forest area ranged between 10 and 50 ha. About 55% of the Serbian and Croatian NIPFs reported to own forests jointly with their family members. The majority of the NIPFs in both the countries reported to use wood from their forests for household heating and the average yearly consumption of wood for such purpose varied between 12 m^3 and 18 m^3. Similarly, the majority of the NIPFs from both the countries also informed that they purchased energy wood from market. The major difference appeared between the NIPFs in terms of selling energy wood from their forests. Around 7% of the Croatian NIPFs sold energy wood from their forests compared to 51% of the Serbian NIPFs. Among the Serbian NIPFs who sold energy wood, only half of them informed the quantity of the energy wood sold by them and the average yearly quantity of energy wood sold was 28 m^3.

Table 1
Profiles of the NIPFs participated in the study.

Information of the NIPFs	Croatia (N=82)	Serbia (N=150)
Section A		
Gender		
Male	5%	11%
Female	95%	89%
Age group (years)		
< 30	1%	1%
31–50	55%	35%
51–60	29%	38%
> 60	15%	26%
Education		
Primary school or less	6%	30%
Above high school and university	17%	7%
High school	71%	63%
Occupation		
Public sector employee	36%	24%
Private sector employee	41%	7%
Farmer	3%	20%
Entrepreneur	2%	10%
Retired	18%	29%
Other	–	10%
Residence		
Nearby own forest property	92%	95%
Far from own forest property	7%	5%
Section B		
NIPFs own forests alone	88%	61%
Average area of forest owned alone	2.5 ha	6.9 ha
NIPFs own forest jointly	55%	55%
Average area of forest owned jointly	2.4 ha	6.5 ha
Types of forests		
Mixed forest	82%	77%
Purely high forest	17%	1%
Purely Coppice forest	1%	22%
Section C		
Use of wood from own forest for heating household		
Yes	79%	95%
No	21%	5%
Average yearly quantity of wood used for heating household	12 m^3	18 m^3
Buying of energy wood from market for household		
Yes	27%	5%
No	73%	95%
Selling of wood from own forest for energy production		
Yes	7%	51%
No	93%	49%
Average yearly quantity of wood sold for energy production	–	28 m^3

3.2. NIPFs' perceptions of energy wood production

NIPFs' perceptions of energy wood production are presented in Table 2. The majority of them perceived that they were familiar with energy wood production related issues (*Item* 1) though such percentage was lower among the Croatian NIPFs compared to the Serbian NIPFs. Statistically significant differences appeared between the NIPFs in these two countries related to their perceived familiarity with energy wood production (t (230)=3.21, $p<0.01$). However, the effect size was moderate (Cohen's d=0.45). The Serbian NIPFs appeared to perceive themselves more familiar with energy wood production (M=3.74, SD=0.87) compared to their Croatian counterparts (M=3.26, SD=1.20). Regarding the development of energy wood market in the two countries (*Item* 2), slightly above half of the Croatian NIPFs agreed that such market was not developed in Croatia compared to one-third of the Serbian NIPFs who agreed similarly. On the contrary, half of the Serbian NIPFs disagreed with that notion.

Table 2
NIPFs' perceptions of energy wood production in Croatia and Serbia.

Items related to Perceptions		Croatia (%)		Serbia (%)	
		Agreement (Disagreement)	DKn	Agreement (Disagreement)	DKn
1.	I am familiar with energy wood production related issues in my country (*familiarity*)	58 (24)	18	74 (21)	5
2.	Energy wood market in my country is not developed (*market*)	53 (5)	42	33 (52)	15
3.	Price of energy wood in my country is not attractive compared to the price of timber (*price*)	24 (9)	67	52 (43)	5
4.	There is no competition between energy wood and timber production in my country (*competition*)	21 (7)	72	69 (23)	8
5.	Energy wood business cannot create new jobs in my country (*new jobs*)	8 (82)	10	9 (84)	7
6.	Energy wood business from private forests could be a viable commercial opportunity in my country (*commercial opportunity*)	72 (4)	24	71 (14)	15
7.	It is difficult to get bank loan to start energy wood business in my country (*bank loan*)	42 (3)	55	32 (4)	64
8.	Fragmented private forest parcels in my country are barrier for energy wood production on a large scale (*fragmentation*)	96 (4)	–	71 (24)	5
9.	Most of the elderly private forest owners in my country are not interested in energy wood production (*elderly NIPFs*)	82 (12)	6	33 (67)	–
10.	Young private forest owners in my country are interested in energy wood production (*young NIPFs*)	88 (1)	11	55 (45)	-
11.	Present policies in my country are not favorable towards energy wood production from private forests (*present policy*)	63 (6)	31	87 (4)	9
12.	There is no need for new policies to support energy wood production from private forests my country (*new policy*)	7 (65)	28	5 (88)	7
13.	Public forestry institutions in my country are competent enough to address energy wood production related issues from private forests (*public forestry institution*)	80 (12)	8	94 (5)	1
14.	In my country, there is a need for a competent private forestry institution to address energy production related issues from private forests (*private forestry institution*)	96 (1)	3	92 (4)	4

Notes: Agreement=strongly agree *plus* Agree; disagreement=strongly disagree *plus* disagree; DKn=I do not know; all percentages have been rounded off; names in *Italics* inside parentheses corresponding to each *perception* related item show the short form of that item. The coding was done as *strongly agree*=5, *agree*=4, *I do not know*=3, *disagree*=2, and *strongly disagree*=1.

About 52% of the Serbian NIPFs agreed that the price of energy wood was not attractive compared to the price of timber in their country, while 42% of them disagreed (*Item* 3). In contrast, slightly over one-fifth of the Croatian NIPFs agreed that the energy wood price in Croatia was not attractive, while the majority of them (67%) did not seem to be aware of that issue. Statistically significant differences (t (229)=9.50, $p<0.01$) appeared with a large effect size (Cohen's d=1.37) between the NIPFs in these two countries related to this price issue. The Serbian NIPFs appeared to be more in agreement (M=3.53, SD=0.98) with that notion compared to the Croatian NIPFs (M=1.90, SD=1.37). Regarding competition between energy wood and timber production (*Item* 4), the majority of the Serbian NIPFs perceived that there was no competition between the two in their country. However, the majority of the Croatian NIPFs (72%) appeared to be unaware of that issue while about one-fifth of them perceived that there was no such competition in their country. Statistically significant differences were found between the NIPFs in the two countries over this issue (t (230)=11.54, $p<0.01$) with a large effect size (Cohen's d=1.63). The Serbian NIPFs were more in agreement (M=3.70, SD=1.09) with that statement compared to the Croatian NIPFs (M=1.77, SD=1.28).

Between 70-80% of the NIPFs in both the countries agreed that energy wood business could create new jobs (*Item* 5) and it could also be a viable commercial opportunity (*Item* 6). In spite of such positive perceptions, about 42% of the Croatian and 32% of the Serbian NIPFs acknowledged the difficulties in obtaining bank loan to start energy wood business (*Item* 7). However, more than half of the NIPFs in these two countries appeared to be unaware of bank loan related difficulties for energy wood business. Over 90% of the Croatian and 70% of the Serbian NIPFs perceived the fragmented forest parcels as barrier against mobilizing energy wood from their forests (*Item* 8). There was a statistically significant difference (t (230)=5.98, $p<0.01$) between the NIPFs in these two countries regarding this barrier against energy wood mobilization and the effect size was also large (Cohen's d=0.88). The Croatian NIPFs appeared to be more in agreement with this notion (M=4.40, SD=0.89) compared to the Serbian NIPFs (M=3.75, SD=0.56).

It appeared that while about 82% of the Croatian NIPFs perceived that the elderly NIPFs in their countries were not interested in producing energy wood from their forests, only 33% of the Serbian NIPFs perceived that notion in the similar way (*Item* 9). Statistically significant difference (t (230)=4.83, $p<0.01$) appeared with a moderate effect size (Cohen's d=0.64) between the NIPFs in the two countries regarding this perception. The Croatian NIPFs appeared to be more in agreement (M=3.79, SD=0.89) with the notion compared to their Serbian counterparts (M=3.26, SD=0.75). On the aspect of younger NIPFs' interests in energy wood production (*Item 10*), about 88% of the Croatian and 55% of the Serbian NIPFs perceived that the younger NIPFs in their countries were interested in energy wood production from their forests while large differences appeared among the respondents between the two countries who perceived that notion in the opposite way (e.g., 1% in Croatia, 45% in Serbia).

The majority of the NIPFs in both the countries agreed that the existing policies in their countries were not supportive for producing energy wood from private forests (*Item* 11). Statistically significant differences (t (230)=4.40, $p<0.01$) appeared between the NIPFs in the two countries related to this perceptions though the effect size was moderate (Cohen's d=0.63). The Serbian NIPFs were more in agreement (M=4.42, SD=1.15) with that notion compared to their Croatian counterparts (M=3.32, SD=1.65). Similarly, about 65% and 88% of the Croatian and Serbian NIPFs, respectively agreed that there was a need for introducing new policies in their countries to support energy wood production from private forests (*Item* 12). About 80% of the Croatian and 94% of the Serbian NIPFs perceived that the public forestry institutions in their countries were competent enough to support energy wood production from private forests (*Item* 13). There was a statistically significant difference (t (229)=4.83, $p<0.01$) though with a

moderate effect size (Cohen's $d=0.62$) between the NIPFs in the two countries related to their perceptions of the competence of the public forestry institutions related to energy wood production from private forests. The Serbian NIPFs were more positive ($M=4.28$, $SD=0.64$) in their perceptions compared to their Croatian counterparts ($M=3.78$, $SD=0.93$). Although the NIPFs considered their public forestry institutions competent to support energy wood production from private forests, more than 90% of the NIPFs in both the countries also agreed to the need for establishing a competent private institution to address the issues related to energy wood production from private forests (*Item* 14). There was a statistically significant difference in their perceptions of this issue (t (196)$=11.44$, $p<0.01$) with a large effect size (Cohen's $d=1.37$). The Croatian NIPFs more strongly perceived ($M=4.29$, $SD=0.73$) the need for private forestry institution compared to the Serbian NIPFs ($M=1.96$, $SD=2.29$).

In terms of age, it appeared that the NIPFs below 50 years of age more strongly perceived ($M=3.42$, $SD=1.97$) the need than their elderly NIPFs ($M=2.30$, $SD=2.24$) did for establishing a competent private institution for addressing the challenges in energy wood production from private forests and there was a statistically significant difference in their such perceptions (t (224)$=4.03$, $p<0.01$) though the effect size was moderate (Cohen's $d=0.53$). In terms of gender, a statistically significant difference appeared (t (230)$=3.10$, $p<0.01$) with a moderate effect size (Cohen's $d=0.64$) between the male and the female NIPFs related to their perceptions of new job creation through energy wood production from private forests. The female NIPFs appeared to be more positive ($M=3.25$, $SD=0.96$) compared to the male NIPFs ($M=2.70$, $SD=0.73$). The level of education also appeared to be significantly related with the NIPFs' perceptions of energy wood production from private forests. There was a statistically significant difference (t (230)$=2.35$, $p<0.05$) with a moderate effect size (Cohen's $d=0.45$) between the NIPFs who had only school level education (i.e., 87% of the NIPFs) and those had above school level education (i.e., 13% of the NIPFs). It appeared that the NIPFs with above school level education more strongly perceived ($M=3.41$, $SD=1.11$) that the energy wood market was not developed in their countries compared with the NIPFs having only school level education ($M=2.82$, $SD=1.28$). The NIPFs with above school level education also appeared to be more in agreement ($M=4.41$, $SD=0.56$) than the rest ($M=3.92$, $SD=0.86$) over the issue that fragmented private forest parcels were a barrier against energy wood harvesting from such forests and a statistically significant difference (t (230)$=2.97$, $p<0.01$) appeared albeit with a moderate effect size (Cohen's $d=0.65$).

Statistically significant differences appeared in terms of location of the NIPFs' residence (near or far from their forests) and their perceptions related to energy wood production. It appeared that the NIPFs who resided far (> 5 km) from their forests more strongly agreed than those who resided near (1-5 Km) to their forests that the energy wood market was not developed in their countries (t (24)$=5.23$, $p<0.01$, Cohen's $d=0.85$); price of energy wood was not attractive compared to price of timber (t (13)$=2.61$, $p<0.05$, Cohen's $d=0.67$); lack of interests among elderly forest owners in energy wood production (t (229)$=2.46$, $p<0.05$, Cohen's $d=0.76$); and difficulties in getting bank loans for starting energy wood related business (t (229)$=2.71$, $p<0.01$, Cohen's $d=0.79$). It appeared that the NIPFs who were employed in private sector perceived more strongly ($M=3.82$, $SD=1.49$) the need for a competent private institution to address the challenges of energy wood production from private forests than the public sector employees ($M=2.89$, $SD=2.23$) and the difference was statistically significant with a moderate effect size (t (107)$=2.58$, $p<0.05$, Cohen's $d=0.49$). Statistically significant difference (t (96)$=4.20$, $p<0.01$, Cohen's $d=0.65$) also appeared between the NIPFs who were retired and the NIPFs who were employed related to their perceptions of this private institution aspect where the retired NIPFs did not perceive so strongly the need for establishing such an institution compared to the working NIPFs.

3.3. NIPFs' attitudes to energy wood production

There were six items that measured the NIPFs' attitudes in terms of their interests and willingness related to participating in energy wood production activities (Table 3). It appeared that the majority of the NIPFs in both the countries were interested in producing energy wood from their forests (*Item* 15) and they were also highly interested in producing energy wood over timber production in the presence of stable energy wood market in their countries (*Item* 16). The majority of the NIPFs in both the counties also demonstrated positive willingness towards planting short rotation trees (*Item* 17) as well as exotic trees (*Item* 18) in their forest properties for producing energy wood. Statistically significant differences with large effect size appeared between the Croatian and Serbian NIPFs in their attitudes towards planting short rotation trees (t (230)$=6.71$, $p<0.01$, Cohen's $d=0.89$) and exotic trees (t (230)$=5.56$, $p<0.01$, Cohen's $d=0.81$) for energy wood production. The Serbian NIPFs showed more positive attitudes ($M=4.64$, $SD=0.68$) compared to the Croatian NIPFs ($M=3.94$, $SD=0.88$) towards planting short rotation trees for energy wood production. The Serbian NIPFs were also more positive ($M=4.32$, $SD=0.85$) than their Croatian counterparts ($M=3.41$, $SD=1.33$) related to planting exotic trees for energy wood production.

Over 90% of the NIPFs in both the countries revealed their willingness to cooperate with other NIPFs in matters related to energy wood production though there was a statistically significant difference with moderate effect size between the NIPFs' willingness (t (230)$=4.91$, $p<0.01$, Cohen's $d=0.65$) between the countries where the Serbian NIPFs appeared to be more willing to cooperate ($M=4.45$, $SD=0.75$) than the Croatian NIPFs ($M=4.01$, $SD=0.60$). On the notion of training, the majority of the Croatian NIPFs showed positive attitudes towards training compared to less than half of the Serbian NIPFs who did so. A statistically significant difference (t (230)$=5.87$, $p<0.01$, Cohen's $d=0.79$) with a large effect size appeared between the NIPFs in the two countries where the Croatian NIPFs were more positive ($M=3.91$, $SD=0.65$) towards receiving training related to energy wood production than the Serbian NIPFs ($M=3.30$, $SD=0.93$).

Further analysis revealed that the NIPFs below 50 years of age were more positive ($M=3.89$, $SD=0.58$) towards training than the NIPFs who were above 50 years of age ($M=3.23$, $SD=0.98$) and the difference was statistically significant with a large effect size (t (230)$=4.91$, $p<0.01$, Cohen's $d=0.81$). No statistically significant differences appeared in terms of the NIPFs' gender and residence with regard to their attitudes to energy wood production. However, it appeared that the NIPFs having only school level education were more willing ($M=4.46$, $SD=0.77$) to plant short rotation trees for energy wood production than the NIPFs with a higher level of education ($M=3.90$, $SD=1.01$) and the difference between the two was statistically significant with a moderate effect size (t (230)$=3.52$, $p<0.01$, Cohen's $d=0.62$). Similarly, the NIPFs with only school level education appeared to be more willing ($M=4.36$, $SD=0.69$) to cooperate with other NIPFs than the NIPFs with above school level education ($M=3.83$, $SD=0.80$) and the difference appeared to be statistically significant with a moderate effect size (t (230)$=3.82$, $p<0.01$, Cohen's $d=0.70$). There were also statistically significant differences with low to medium effect sizes between the retired NIPFs and those who were still working related to their attitudes to energy wood

Table 3
NIPFs' attitudes to energy wood production in Croatia and Serbia.

Items related to perceptions		Croatia (%)		Serbia (%)	
		Agreement (disagreement)	DKn	Agreement (disagreement)	DKn
15.	I am not interested in energy wood production over valuable timber production from my forest (*no interest*)	20 (74)	6	31 (66)	3
16.	I will be interested in energy wood production over timber production if there will be a stable energy wood market in my country (*interested in the future*)	95 (3)	2	71(26)	3
17.	I am willing to plant short rotation trees in my forest property for energy wood production (*planting short rotation trees*)	89 (5)	6	94 (5)	1
18.	I am also willing to plant exotic trees in my forest property for energy wood production (*planting exotic trees*)	69 (10)	21	88 (11)	1
19.	I am willing to cooperate with other private forest owners in terms of energy wood production (*cooperating with NIPFs'*)	96 (2)	2	90 (9)	1
20.	I want training to make me competent in energy wood production related matters (*training*)	92 (4)	4	40 (60)	–

Notes: Agreement=strongly agree *plus* agree; disagreement=strongly disagree *plus* disagree; DKn= I do not know; all percentages have been rounded off; names in *Italics* inside parentheses corresponding to each *attitude* related item show the short form of that item. The coding was done as *strongly agree*=5, *agree*=4, *I do not know*=3, *Disagree*=2, and *strongly disagree*=1.

production over timber production (t (79)=3.19, $p<0.01$, Cohen's d=0.52), planting exotic trees for energy wood production (t (214)=1.52, $p<0.05$, Cohen's d=0.22), cooperating with other NIPFs (t (79)=2.05, $p<0.05$, Cohen's d=0.34) and receiving training (t (81)=4.11, $p<0.01$, Cohen's d=0.68) for energy wood production. It appeared that the retired NIPFs were less positive in their attitudes compared to the employed NIPFs in energy wood production related matters.

3.4. Key dimensions of the NIPFs' perceptions and attitudes related to energy wood production

Principal Component Analysis (PCA) with the pooled data revealed the key dimensions of the NIPFs' perceptions and attitudes related to energy wood production (Table 4). The items with dimension loading less than 0.50 were left out from the analysis. PCA revealed two key dimensions of the NIPFs' perceptions and attitudes related to energy wood production, which explained 75% of the variation in the data. There was an *institutionalists* dimension (α=0.75), which consisted of two items that revealed the NIPFs' perceptions of the institutional role (both public and private) for supporting energy wood production related matters from private forests in their countries. This dimension accounted for 42% of the variation in the data. The other key dimension *enthusiasts* (α=0.78) consisted of items that showed the NIPFs' attitudes towards planting both short rotation and exotic trees on their forest properties for energy wood production as well as cooperating with other NIPFs in their countries related to that matter. In other words, this dimension revealed the NIPFs' behavioral intentions towards energy wood production related issues, which accounted for 33% of the variation in the data. Fig. 1 represents the plotting of the items according to their loadings on the two key dimensions *institutionalists* and *enthusiasts*.

3.5. Multiple regression analysis to explain NIPFs' attitudes to energy wood production

A series of multiple regression analysis were conducted with the data from each country to reveal the explanatory power of the NIPFs' perceptions on their attitudes to energy wood production. The predictors or independent variables (IVs) were the fourteen perceptions related items while the dependent variable was the sum of the six items related to the NIPFs' attitudes to energy wood production. The results indicated that the Tolerance coefficients

Table 4
Results of the principal component analysis related to the NIPFs' perceptions of and attitudes to energy wood production in Croatia and Serbia.

Items (short forms)	Loadings on dimensions	
	Institutionalists	Enthusiasts
Public forestry institution	**0.91**	0.09
Private forestry institution	**0.86**	0.24
Planting short rotation trees	0.24	**0.86**
Planting exotic trees	0.18	**0.83**
Cooperating with NIPFs	0.05	**0.78**

Notes: Rotated components using Varimax; Rotation converged in three iterations; Kaiser–Meyer–Olkin measure of sampling adequacy > 0.69; Bartlett's test of sphericity= < 0.001; loading on dimensions above.50 are highlighted.

were higher than 0.20 and the variance-inflation factor coefficients were lower than 4.0, denoting the absence of multivariate multicollinearity in the data [19]. The Dublin–Watson statistic showed a value of 1.85 for Croatia and 1.62 for Serbia, which indicated that the independent errors in the models were tenable. The final models produced significant equations: Croatia ($F_{1,78}$=21.69; $p<0.001$; *Adj.* R^2=0.21) and Serbia ($F_{4,145}$=15.65; $p<0.001$; *Adj.* R^2=0.28). The IVs included in the final models are shown in Table 5. The results showed that the explanatory variable *Present Policy* had statistically significant relation with the Croatian model and it was the only IV that was retained in that model. *Commercial Opportunity* and *Private Forestry Institution* had statistically significant relations with the Serbian model. It appeared that *Bank Loan* and *Price* emerged as statistically significant explanatory variables of the NIPFs' attitudes to energy wood production only in Serbia though *Price* was negatively related with the model. In total, the models explained between 21% and 28% of the variations in the NIPFs' attitudes to energy wood production in the two countries.

4. Discussion

Sustainable management of private forests and addressing the needs of the NIPFs are two major challenges that demand considerable attention from the Croatian and Serbian policy makers. National forestry related policies and strategies have been evolving over the last decade in these countries and they have

Table 5
Coefficients and *t*-values of the independent variables on the dependent variable *attitudes to energy wood production* among the NIPFs in Croatia and Serbia.

Country	Independent variables retained in the final models	β	t-Value
Croatia	*Present policy*	0.47***	4.66
Serbia	*Commercial opportunity*	0.30***	3.96
	Private forestry institution	0.27***	3.65
	Bank loan	0.18*	2.34
	Price	−0.16*	−2.23

Note: All Beta (β) values are standardized regression coefficients with associated *t*-statistics and probability values.
*** $p < 0.001$.
* $p < 0.05$.

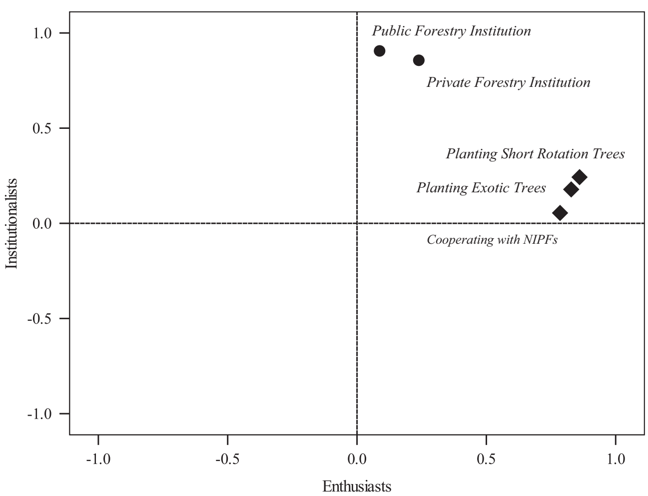


Fig. 1. Loading of the key dimensions on the rotated space (Varimax) related to the NIPFs' perceptions of and attitudes to energy wood production.

someway recognized the challenges that their private forestry sector has been experiencing for decades. However, not much progress has been achieved with regard to sustainable management of private forests in these two countries apart from a few positive changes that have taken place recently (e.g., establishment of the private forest owners' union in Croatia). Therefore, potentials from private forests remained largely unexploited in both the countries due to inadequate care, attention, and management [3]. However, it has to be taken into consideration that institutions and policies related to forestry are in a transitioning phase in both Croatia and Serbia and they face significant challenges from the impacts of globalization and recent economic changes in Europe [3]. Despite some recent initiatives that have been introduced by the policy makers to improve infrastructure and technical expertise related to bioenergy production from forest biomass, changing the current situations related to private forest management and motivating the NIPFs in energy wood production will remain as a challenge in these countries. On this background, the study analyzed Croatian and Serbian NIPFs' perceptions and attitudes related to energy wood production from their forests. Socio-demographic profiles of the NIPFs appeared to be quite similar except for their occupation. However, there were large differences between the NIPFs in these two countries in terms of the characteristics of their forest ownerships (e.g., average size of forest area, types of forests, buying of energy wood from market, personal use and selling of energy wood from own forests). A number of differences also appeared among the NIPFs within a country level. These findings reflected that the NIPFs in these two countries and perhaps in the other Western Balkan countries form a heterogeneous group, particularly in terms of size of forest ownerships and number of forest parcels they own. Such heterogeneity among the NIPFs creates a challenge for any policy that aims to improve the situation in private forestry in these countries.

In terms of the NIPFs' perceptions, the study found that the majority of them in both Croatia and Serbia commonly agreed to some potential benefits and challenges of energy wood production from private forests. Regarding the potential benefits, majority of them agreed that energy wood business could create new jobs and it could be a viable commercial opportunity in the future. In terms of potential challenges, the majority of them agreed that the fragmented private forest areas and lack of favorable policies would act as barriers against mobilizing energy wood from their forests. The NIPFs in both the countries strongly perceived the need for new policies to support energy wood production from private forests. However, there were also some inconsistencies between the NIPFs in the two countries in their perceptions related to some issues such as the status of energy wood market in their countries, price of energy wood in comparison to price of timber as well as competition between the two, difficulties in obtaining bank loan for energy wood entrepreneurship, and elderly NIPFs' interests in energy wood production. The NIPFs appeared to be quite optimistic about the younger NIPFs' participation in energy wood production although they were not such positive about the older NIPFs. This was in contrast to the findings by Čavlović [35] who argued that younger NIPFs in Croatia were not interested in working and investing in their forests. However, in this study the NIPFs perhaps considered that the energy wood related businesses could be attractive to the younger NIPFs compared to the traditional timber trade.

In this study, the NIPFs appeared to be quite positive about the competencies of the public forestry institutions in their countries to deal with the challenges regarding energy wood production from private forests. However, they also strongly supported the need for establishing a private forestry institution for addressing those challenges and such strong support was more apparent among the NIPFs employed in private sector compared to the NIPFs working in public sector and also those who were retired. It could indicate that though there have been criticisms against the public forestry institutions for their inadequacy to deal with private forestry related issues in Croatia and Serbia, the NIPFs from these countries still consider public institutions capable of addressing their issues. These perceptions could emerge from the political situation that prevailed in these countries before the 1990s when they were under the rules of socialistic governments and governments used to control all aspects of forest management through centralized planning systems. The majority of the NIPFs participated in the study were above 50 years of age and therefore, their support for public forestry institutions was not totally unexpected even though in today's situations the NIPFs are free to sell wood from their forests and the government control has largely diminished due to Croatia and Serbia's participation in free-market economy as a result of EU influences.

It was encouraging to find that the NIPFs were positive towards some of the potential benefits of energy wood production from private forests such as creation of new jobs and new business opportunities. These positive perceptions of energy wood production among the NIPFs could encourage them to actually participate in this activity in the future. Therefore, it is important that the bioenergy related initiatives in these countries should contribute towards creating new employment opportunities to increase the social acceptance of forest-based bioenergy projects among various key stakeholder groups. In this context, the Croatian and Serbian policy makers could follow the developments in other European countries where forest-based bioenergy projects

have successfully contributed to improve local economies by creating new jobs. It appeared that the NIPFs did not have much information on the availability of bank loan for energy wood business and they perceived getting bank loan as an obstacle for starting such activity. This situation could be a result of the current global economic crisis, which has had a strong impact in both Croatia and Serbia where getting bank loans for many new projects has become challenging. In addition, commercial way of producing bioenergy from forests has just started in these countries and therefore, getting bank loan can be challenging as banks and other financial institutions could still be unaware of the potentials of such business activities. In these circumstances, the NIPFs could take guidance from the experts working in both private and public forestry institutions to prepare innovative business plans, which banks might consider attractive for financing. An organization like private forest owners' union, which has been recently formed in Croatia, can play an important role in removing this type of obstacle from the financial market and therefore, such type of organization could also be relevant in Serbian context.

The major differences in the NIPFs' perceptions of energy wood appeared related to the status of market and price of energy wood, competition between energy wood and timber production, and older NIPFs' interests in energy wood production. There is no formal market for energy wood in Croatia and Serbia. The trade of energy wood from private forests often takes place in informal ways between the buyers and sellers especially in the rural areas. In Croatia, the majority of the NIPFs appeared to have no idea on the issues related to price and competition, nearly half of them were not certain on the market issue, and only a small percentage of them disagreed with the current situation related to those issues. In Serbian context, though the majority agreed with the issue of price and competition, a considerable portion of them disagreed with the majority of those issues. Moreover, the majority of the Serbian NIPFs perceived their energy wood market as developed and such perceptions did not portray the reality in the energy wood sector in Serbia. On the question of older NIPFs' interests in energy wood production, the majority of the Croatian NIPFs' perceptions perhaps reflected the reality in Croatia while the Serbian NIPFs' perceptions might not be appropriate. To a large extent, these differences in the perceptions of the NIPFs between the two countries could be attributed to the differences in their socio-demographic profiles as the study found some statistically significant differences with regard to the NIPFs' age, gender, education, residence, occupation and their perceptions of energy wood production. Those differences could also be related to the characteristics of NIPFs' forest ownerships (size of property, types of forests, single or joint ownerships) and their use of energy wood and selling them from their forests. The latter type of differences appeared among the NIPFs in the U.S. see [27]; however, they have not been analyzed in this study. However, country level differences in the NIPFs' perceptions could have also emerged due to several other socio-economic factors prevailing in these countries and investigating them with details was beyond the scope of the paper.

The attitudes of the NIPFs towards energy wood production appeared to be quite positive. Such positive attitudes among the NIPFs could be encouraging for the Croatian and Serbian policy makers to take up new initiatives for energy wood mobilization from private forests as they can expect that those initiatives will be supported by the NIPFs. It indicates that although the NIPFs recognized the challenges in energy wood production they also considered the benefits of such activities as significant and therefore, intended to participate in energy wood production. In this context, the findings of this study are similar to the findings from Scandinavia where the NIPFs were also very positive towards energy wood harvesting from their forest see [20, 21, 23]. However, one pre-condition for transforming their positive attitudes to actual involvement in energy wood production should be creating a stable market for energy wood in both the countries. This is one of the key challenges that energy wood business is facing today in Europe. This phenomenon is also to some extent prevailing in the Nordic countries such as Finland and Sweden where bioenergy policies are in general progressive. It was noteworthy to observe that the NIPFs were willing to plant short rotation trees as well as non-native trees on their forest properties to produce energy wood. Therefore, the forestry related institutions in these countries need to evaluate the possibilities of fast growing trees as an option for energy wood production. In Serbia, fast growing tree species such as Poplar has already been planted in large areas and the usefulness of such species for energy wood production should be evaluated. However, careful decision should be taken for planting non-native tree species for energy wood production as that could bring adverse ecological impacts such as loss of forest biodiversity. The only difference that appeared between the Croatian and Serbian NIPFs' attitudes to energy wood production was related to their interests in receiving training for energy wood production, which could be attributed to the age factor among the NIPFs.

The dimensions of the NIPFs' perceptions and attitudes related to energy wood production showed two key dimensions – *institutionalists* and *enthusiasts*. In other words, the first dimension reflected the relevance of both public and private forestry institutions that the NIPFs recognized in improving the pre-conditions for energy wood production from private forests. It also indicated that the NIPFs would attach importance and follow the rules and regulations formulated by these institutions instead of operating on their own. The second dimension revealed the attitudinal aspects of the NIPFs towards energy wood production, which were mostly positive and perhaps emerged as a result of their positive perceptions of energy wood production. The independent variables that explained the NIPFs' attitudes to energy wood production possibly indicated the differences in the country level circumstances for energy wood production. In Croatia, it could be argued that by formulating supportive energy wood production policies the government can remove many of the obstacles in mobilizing energy wood from private forests, which in turn would have positive impacts on the Croatian NIPFs' attitudes to energy wood production. In Serbia, new business opportunities from energy wood production and establishing a competent private forestry institution for addressing the needs of the NIPFs could influence their attitudes to energy wood production. Similarly, improving the availability of bank loan or other financial support for energy wood related business activities could also have positive effects on the NIPFs' attitudes to energy wood production. All these indicate that the future energy wood policies need to address the challenges that the NIPFs are facing in mobilizing energy wood from their forests and the decision makers must include NIPFs along with other key stakeholders in consultations before formulating such policies. However, it should be taken into account that the regression models revealed small effects sizes in both the countries and therefore, further studies should investigate the country level factors that remained unexplained in this study.

From the policy perspectives, new legislations have been emerging in Croatia and Serbia in every sector including forestry and renewable energy along with their processes of becoming new EU Member States by adopting market-based economy [36]. Both the countries, in line with the *Renewable Energy Directive* of the EU, have recently adopted their own NREAPs for the period up to 2020 and those plans among others have emphasized on producing bioenergy from locally available biomass resources. In the field of forestry, Croatian *National Forestry Policy and Strategy of 2003* and the Serbian *Forestry Development Strategy of 2006* have attempted

to address the private forestry related issues including energy wood production. For example, the Serbian *Forestry Development Strategy* has formulated new directions in the development of the private forestry sector with a special focus on getting the small-scale forestry more efficiently managed in the country [37]. In 2010, Serbia also amended its former *Forest Law of 1991* and the new *Forest Law of 2010* has recognized both public and private forest ownerships as equal, so that private forests could get their recognition as an ownership category, opposite from the past times when they were mostly neglected [38]. In addition, the *Biomass Action Plan* of Serbia has estimated the potential of woody biomass for energy production and recommended a number of actions to remove the obstacles in the bioenergy sector in the country [17]. In Croatia, there is a need for a national level action plan on biomass much like Serbia to develop their bioenergy sector. One of the main benefits that Croatia can get from developing such a biomass action plan that it can identify the problems/bottlenecks in the process of biomass utilization for energy production as well as the actions required to overcome them [17].

Therefore, it is necessary that these policies and strategies should be formulated and implemented effectively in both the countries and participation of different stakeholders including the NIPFs would be important for their successful implementation. It appeared from the study that the NIPFs in both the countries had quite positive attitudes towards energy wood production and they were also willing to cooperate with each other in that matter. In this context, private forest owners' associations with clear objectives and strong capacities could motivate the NIPFs particularly the younger ones to be active in energy wood production related issues. However, along with motivating the NIPFs by understanding their perceptions and attitudes to energy wood production it is also necessary to address the technical and economic issues related to energy wood production from private forests in Croatia and Serbia [39]. Future studies would also need to analyze the NIPFs' perceptions and attitudes related to energy wood production in these countries based on their forest ownership characteristics and their energy wood buying and selling behaviors.

5. Conclusions

The study explored perceptions and attitudes related to energy wood production among Croatian and Serbian NIPFs. The results appeared to be relevant for understanding the key issues that the NIPFs perceived as barriers against developing energy wood market in these countries. It was encouraging to observe that the NIPFs demonstrated positive attitudes towards producing energy wood from their forests though they aptly acknowledged the key barriers against energy wood production from their forests in terms of policy, institutions, market, price, and financing among others. At the current situation when various forestry and energy related policies are emerging in Croatia and Serbia, the existing public and private institutions need to play an important role for improving the preconditions of mobilizing energy wood from private forests. In addition, awareness raising among the NIPFs and support them in energy wood supply from their forests by creating a stable energy wood market should be considered under the priority tasks by the policy makers in these countries.

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